CLAIMS

What is claimed is:

1. An apparatus comprising:

a light emitting diode comprising a chip having a light emitting surface that emits light into a medium with a refractive index of less than or equal to approximately 1.25; and

a collimating optical element disposed to receive the light emitted from the light emitting surface of the chip, the collimating optical element having an entrance surface, wherein the medium is disposed between the entrance surface and the light emitting surface of the chip.

2. The apparatus of Claim 1, wherein the collimating optical element and the chip are separated by a distance that is less than or equal to approximately 50% of the width of the chip.

3. The apparatus of Claim 1, wherein the collimating optical element is a lens.

4. The apparatus of Claim 1, further comprising a holding element that holds the collimating optical element.

5. The apparatus of Claim 4, wherein the holding element has a ring shape and includes a notch and the lens has a tab that is held in the notch.

6. The apparatus of Claim 4, wherein the light emitting diode further comprises a submount, the chip being mounted on the submount, and wherein the holding element is mounted on the submount by reflow soldering.

7. The apparatus of Claim 1, further comprising a secondary collimating optical element disposed over the collimating optical element such that the collimating optical element is disposed between the second collimating optical element and the chip.

8. The apparatus of Claim 1, further comprising:

an array of light emitting diodes, each light emitting diode comprising a chip having a light emitting surface that emits light into a medium having a refractive index of less than or equal to approximately 1.25; and

at least one collimating optical element being disposed to receive the light emitted from the light emitting surfaces of each chip, the at least one collimating optical element having an entrance surface, wherein the medium is disposed between the entrance surface of the at least one collimating optical element and the light emitting surface of each chip.

9. The apparatus of Claim 8, wherein the at least one collimating optical element comprises an array of collimating optical elements, each collimating optical element being disposed to receive the light emitted from the light emitting surface of an associated chip, each collimating optical element having an entrance surface, wherein the medium is disposed between the entrance surface and the light emitting surface of the associated chip.

10. The apparatus of Claim 9, wherein the array of collimating optical elements is an integral array of lenses.

11. The apparatus of Claim 9, wherein at least one chip is displaced laterally with respect to the center of the associated collimating optical element.

12. The apparatus of Claim 1, wherein the light emitting diode further comprises a submount and an array of chips mounted on the submount, each chip in the array of chips having a light emitting surface that emits light into a medium having a refractive index of less than or equal to approximately 1.25, and wherein the collimating optical element is disposed to receive the light emitted from the light emitting surface of each chip in the array of chips.

13. The apparatus of Claim 1, further comprising a micro-display disposed to receive light emitted from the light emitting surface of the chip after passing through the collimating optical element.

14. The apparatus of Claim 1, wherein the chip includes one of a wavelength converting layer, a diffractive layer, a micro-refractive layer, and a filter layer and a polarizer layer that forms the light emitting surface.

15. The apparatus of Claim 1, wherein the medium is the ambient environment.

16. The apparatus of Claim 15, wherein the ambient environment is one of air and gas.

17. An apparatus comprising:

a light emitting diode comprising a chip having a light emitting surface, wherein the light emitting surface is not covered by an encapsulant such that the light emitting surface emits light directly into the ambient environment; and

a collimating optical element disposed to receive the light emitted from the light emitting surface of the chip through the ambient environment.

18. The apparatus of Claim 17, wherein the collimating optical element is at least one lens.

19. The apparatus of Claim 17, further comprising a micro-display disposed to receive the light emitted from the light emitting surface of the chip after the light passes through the collimating optical element.

20. The apparatus of Claim 19, further comprising a secondary collimating optical element disposed between the micro-display and the collimating optical element.

21. The apparatus of Claim 17, wherein the light emitting diode further comprises a submount, the apparatus further comprising:

a holding element that holds the collimating optical element, the holding element being mounted on the submount.

22. The apparatus of Claim 21, wherein the holding element has a ring shape and includes a notch and the lens has a tab that is held in the notch.

23. The apparatus of Claim 17, further comprising:

an array of light emitting diodes, each light emitting diode comprising a chip having a light emitting surface, wherein the light emitting surface is not covered by an encapsulant such that the light emitting surface emits light directly into the ambient environment; and

at least one collimating optical element being disposed to receive the light emitted from the light emitting surfaces of each chip.

24. The apparatus of Claim 23, wherein the at least one collimating optical element comprises an array of collimating optical elements.

25. The apparatus of Claim 24, wherein the array of collimating optical elements is an integral array of lenses.

26. The apparatus of Claim 24, wherein at least one chip is displaced laterally with respect to the center of the associated collimating optical element.

27. The apparatus of Claim 17, wherein the light emitting diode further comprises a submount and an array of chips mounted on the submount, each chip in the array of chips having a light emitting surface and wherein the light emitting surface of each chip in the array of chips is not covered by an encapsulant, and wherein the collimating optical element is disposed to receive the light emitted from the light emitting surface of each chip in the array of chips through the ambient environment.

28. The apparatus of Claim 17, wherein the chip includes a wavelength converting layer that forms the light emitting surface.

29. The apparatus of Claim 17, wherein the ambient environment is one of air and gas.

30. The apparatus of Claim 17, wherein the chip includes one of a wavelength converting layer, a diffractive layer, a micro-refractive layer, and a filter layer and a polarizer layer that forms the light emitting surface.

31. An apparatus comprising:

a light emitting diode comprising a chip having a light emitting surface that emits light into a medium with a refractive index of less than or equal to approximately 1.25;

a collimating optical element disposed to receive the light emitted from the light emitting surface of the chip; and

a micro-display disposed to receive the light emitted from the light emitting surface of the chip after the light passes through the collimating optical element.

32. The apparatus of Claim 31, wherein the collimating optical element is at least one lens.

33. The apparatus of Claim 31, further comprising a secondary collimating optical element disposed between the micro-display and the collimating optical element.

34. The apparatus of Claim 31, wherein the light emitting diode further comprises a submount, and the apparatus further comprising:

a holding element that holds the collimating optical element, the holding element being mounted on the submount.

35. The apparatus of Claim 34, wherein the holding element is annular and includes a notch and wherein the collimating optical element has a tab that is held in the notch.

36. A method comprising:

providing a light emitting diode chip with a light emitting surface that emits light directly into a medium having a refractive index of less than or equal to approximately 1.25;

providing an optical element; and

mounting the optical element with respect to the light emitting diode so that light emitted from the light emitting surface passes through the medium prior to being received by the optical element.

37. The method of Claim 36, wherein the medium having a refractive index of less than or equal to approximately 1.25 is one of air and gas.

38. The method of Claim 36, further comprising:

focusing the light emitted from the light emitting surface with the optical element after the light passes through the medium; and

causing the focused light to be incident on a target.

39. The method of Claim 36, wherein mounting the optical element comprises mounting the optical element to a submount on which the light emitting diode chip is mounted.

40. The method of Claim 36, wherein the optical element is a primary optical element, the method further comprising providing a secondary optical element and mounting the secondary optical element to receive light from the primary optical element.

41. The method of Claim 36, wherein mounting the optical element comprises laterally displacing the center of the optical element with respect to the light emitting surface chip.

42. The method of Claim 36, further comprising:

providing a plurality of light emitting diode chips each having a light emitting surface that emits light directly into a medium having a refractive index of less than or equal to approximately 1.25; and

wherein mounting the optical element comprises mounting the optical element with respect to the plurality of light emitting diode chips so that light emitted from the light emitting surface of each of the light emitting diode chips passes through the medium prior to being received by the optical element.